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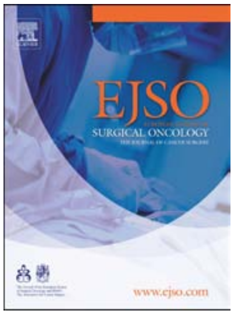
Accepted Manuscript



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PII: S0748-7983(09)00123-1

DOI: 10.1016/j.ejso.2009.04.006

Reference: YEJSO 2826

To appear in: *European Journal of Surgical Oncology*

Received Date: 14 August 2008

Revised Date: 1 April 2009

Accepted Date: 3 April 2009

A treatment algorithm for managing giant mandibular ameloblastoma: 5-year experiences in a Paris university hospital

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Abstract

AIMS: To review our experiences with giant mandibular ameloblastoma (GMA) over a 5-year period, and to formulate a treatment algorithm for managing this tumour.

METHODS: We retrospectively reviewed all GMA patients who underwent segmental mandibulectomy and immediate free fibular osteoseptocutaneous flap reconstruction (SM-IFFOFR) by a single reconstructive team from 2002 to 2006. All treatment methods and outcomes were analysed.

FINDINGS: Forty-four ameloblastoma patients were operated during this study period. Sixteen cases had GMA, of which 9 patients were included in this series (mean age: 35 years). The defects in the mandible ranged from 7 to 16 cm in length (mean: 12 cm). The average length of the harvested fibula was 11 cm, and the number of osteotomies ranged from 1 to 2. The mean ischemic time was 137 minutes (range: 90-180 minutes). Neck recipient vessels were used for flap perfusion in all cases. All but one flaps were viable without any complications, whilst partial skin-island necrosis occurred in 2 patients. Hospital stay was 2 weeks in most of the patients. No tumour recurrence was found during the follow-up period (range: 26-73 months). Dental implants were placed in 2 patients.

CONCLUSIONS: Despite several limitations of this study, we suggest that a radical approach with the SM-IFFOFR is an effective treatment for GMA. Further well-designed, larger series with longer follow-up periods are still encouraged.

Key words: Giant ameloblastoma; jaw tumour; microvascular surgery; immediate reconstruction; fibular free flap

Introduction

Ameloblastoma is a benign odontogenic tumour of the jaws with a locally aggressive behaviour and a high recurrent rate. In general, ameloblastoma can be categorised into 3 types: conventional solid multicystic, unicystic and peripheral ameloblastoma. Conventional ameloblastoma is a slow growing, but locally invasive, tumour. Some ameloblastomas become gigantic and destroy adjacent tissues. Conversely, unicystic ameloblastoma frequently occurs in younger populations, and possesses a less aggressive nature and a lower recurrent rate. It can be either a tumour de novo or a tumour arising from an odontogenic cyst. Both solid and unicystic ameloblastoma commonly occur in the mandible, especially the molar-ramus area.[1-6]

Various therapies for ameloblastoma have been reported. However, the universally accepted approach remains unsettled. It can range from conservative treatments, such as enucleation with or without curettage, to aggressive treatments which include peripheral ostectomy and resection.[1,2,7] Once mandibular ameloblastoma becomes gigantic, it requires a radical approach.[2,3] Free flap reconstruction is necessary when the resected defect is larger than 5 cm. Some authors reported the treatment of extensive ameloblastoma using radical excision with immediate microvascular reconstruction.[4-6]

Until now, there has been neither definition of nor definite treatment consensus on giant mandibular ameloblastoma (GMA). In this paper, GMA is defined as mandibular ameloblastoma which consists of three components: 1) large size (> 5 cm in length), 2) thinning of the inferior and/or posterior mandibular borders, and 3) considerable jaw expansion. The aim of this study was to review our experiences with this tumour over a 5-year period, and to institute an algorithm for managing GMA.

Methods

We retrospectively reviewed all ameloblastoma patients treated between 2002 and 2006 at the Pitié-Salpêtrière University Hospital. In our department, one of 2 microsurgical teams used an osteomyocutaneous flap for reconstructing the resected jaws, whereas our team favoured an osteoseptocutaneous flap. Had we included the patients treated by the other team, our study results would have been skewed. Hence, we decided to analyse our GMA patients only.

All the patients in this series received segmental mandibulectomy and immediate free fibular osteoseptocutaneous flap reconstruction (SM-IFFOFR) via a transcervical route. Leg angiography was performed preoperatively to detect any anatomical variation or pathology of the peroneal circulation. The extent of resection depended upon the tumour size and the extent of destruction in computed tomography (CT). We used the Gilbert's lateral approach [8] and the muscle-sparing technique [9] under tourniquet for flap harvesting. The skin island was centred at the middle and/or lower thirds, and its size depended upon recipient needs. All the dissections and microanatomoses of the fibular free flap (FFF) were performed or closely controlled by the senior consultant (AC).

The clinical data were obtained through chart reviews and included age at presentation, sex, tumour location, date and extent of resection, flap ischemia time, fibular bone length, skin paddle size, amount of graft osteotomy, recipient vessels, anticoagulant regimen, length of hospital stay, surgical complications, date of tumour recurrence, and date of last follow-up visit. The two independent assessors (AC and PP) evaluated the clinical outcomes. If agreement could not be reached, advice was sought from a third party.

The recommendations of the Helsinki declaration were thoroughly maintained during this study. Ethical approval was exempted by the Committee of Human Subject Protection in Biomedical Research (Comité de Protection des Personnes: CPP) of Paris and its suburb, whilst we followed the national guideline 'Déclaration de Commission Nationale de l'Informatique et des Libertés (CNIL)' to protect the patient confidentiality.

Findings

Forty-four ameloblastoma patients were identified during the study period. Of those, 16 patients had GMA, of which 9 patients underwent SM-IFFOFR by our team. The mean age of the patients (8 men and 1 woman) was 35 years (range: 18-70 years). The defects ranged from 7 to 16 cm in length (mean: 12 cm). According to the classification by Jewer et al [10], we included 5 H, 2 LCL, 2 LC defects (H = hemimandible segment that involves the condyle, L = lateral segments without the condyle, C = central segments that includes both canine teeth).

The average length of the harvested fibula was 11 cm, and the skin paddle size ranged from 22 to 70 cm^2. We osteotomised the grafts on the bench to prepare their curvature. Without the use of a preoperative template, we did one osteotomy in 3 flaps, and two osteotomies were performed in the remaining. We used miniplates and screws to fix each osteotomy site and between the FFF and the native mandible.

The flap artery and 2 veins were anastomosed to the recipient vessels (5 with facial artery, 2 with superior thyroid artery, and 1 with lingual artery; 4 with facial vein, 2 with superior thyroid vein, 2 with thyrolinguofacial trunk, and 1 with internal jugular vein). No autogenous vein graft was used. The thyrocervical trunk and internal jugular vein were anastomosed using the end-to-side technique, whereas the other vessels were anastomosed end-to-end. All the donor and recipient vessels were topically irrigated by heparinised saline solution. Return of flap circulation was judged by bleeding of periosteal bone and a soft-tissue cuff. The mean ischemic time was 137 minutes (range: 90-180 minutes). Donor sites were closed primarily in 6 patients and with a split-thickness skin graft in the remaining of the patients.

Postoperatively, pharmacologic regime was low-molecular-weight heparin during the first few days for deep vein thrombosis prophylaxis. Four patients received an intermaxillary fixation for 3-8 weeks to control jaw position and to stabilise osteosynthesis materials. Patients began self-ambulation with crutches 3-5 days postoperatively. Hospital stay was 2 weeks in all except 2 patients. The prolonged hospitalisation was due to major complications: 1 grave haematoma and 1 failed flap.

Complete flap survival was 8 out of 9 flaps, and partial skin-island loss occurred in 2 patients. A failed flap occurred one week postoperatively because of flap necrosis and subsequent infection, requiring transplant removal. Although a repeat flap transfer was possible,[3] the patient gained his weight 30 kg a few months after operation. This made repeat FFF more difficult, so we chose to perform secondary non-vascularised iliac grafting.

No serious complications were found in all cases, except a conspicuous scar at the donor sites. Postoperative facial appearances, assessed by the method of Boyd et al [11], were fair or excellent. Only 2 patients received implant-supported rehabilitation. There has been no tumour recurrence to date. The follow-up duration was 53 months on average (range: 26-73 months).

Discussion

1. A rational approach for treating ameloblastoma

Ameloblastoma is a benign, but locally aggressive, odontogenic tumour. A conservative approach usually yields a high recurrent rate, thereby requiring close vigilance. Repeat treatment of a small recurrence is more acceptable than jaw amputation with complex reconstructive surgery. An extensive tumour may be destructive and life-threatening, necessitating adequate excision which depends upon its site and extension. Because of the infiltrative lesion characteristics, radical resection is favourable with the aid of preoperative CT. The tumour border is always beyond the macroscopic surface and the radiographic boundaries. Thus, removal of uninvolved bone 1 to 2-cm beyond the clinical tumour margin, is of great help to ensure clearance from microscopic infiltration.[2-7] All involved teeth must be removed because small tumour islands can persist within the periodontal ligament.[12]

We established an algorithm for managing mandibular ameloblastoma (Fig. 1). Although the distinction between 'persistence' and 'recurrence' following a conservative approach remains unclear,[3] clinical findings of individual patient dictates the treatment for each patient. We believe that conservative treatment creates higher quality of life. Thus, it should be used (in conjunction with adequate postoperative surveillance) before more radical therapies. However, GMA patients are suited for the SM-IFFOFR whenever feasible (Fig. 2). We avoid using a lip split incision in Blacks because of a high incidence of a hypertrophic scar and keloid.[13] Supraperiosteal dissection with/without excision of overlying mucosa is indicated if the tumour perforates cortices.[3]

We agree with the suggestion by Bui et al [14] that delayed or secondary reconstruction should be the treatment of choice in medically unstable patients, or when there are no local options such as available recipient vessels. However, a history of previous surgery probably makes the success of secondary reconstruction drop considerably. This may be due to scarring and fibrosis secondary to earlier surgery. Besides, the creation of a tunnel for the neocondyle during the secondary reconstruction may endanger the facial nerve.[15]

Recurrences of ameloblastoma commonly occur during the 5-year postoperative period.[5] Hence, patient follow-up using clinical examination and panoramic radiograph should be done twice a year in the first 5 years and then once a year for at least 10 years.[2,6] Patients undergoing the SM-IFFOFR necessitate more frequent follow-up during the first-year postoperative course.

2. Considerations on the SM-IFFOFR

2.1 Advantages

SM-IFFOFR eradicates the tumour, lowers the recurrence rate, restores the function via placement of vascularised tissues into the defect, provides primary bone healing, reduces the risk of scarring, contraction and fibrosis, and creates high quality of life.[2,5,15,16] Reconstruction of segmental mandibular defects requires the restoration of jaw continuity, osseous bulk, bone quality, aesthetic facial form, alveolar bone height, and soft tissue (that enhances tongue mobility, speech, swallowing and subsequent dental rehabilitation).[15-18] Osseous free flaps for mandibular reconstruction can be obtained from the fibula, ilium, scapula, rib, metatarsus and radius.[15,17]

FFF provides several advantages over other donor sites. These include ample bone length, ease of graft dissection and contouring, a two-team approach, long pedicles with large calibre vessels, and minimal donor-site morbidity. Its vascular supply is recipient-independent. Owing to the profuse periosteal blood supply, careful osteotomising the flap rarely harms its vascularity. Moreover, this flap offers excellent bicortical bone stock for dental implant placement and a versatile cutaneous unit for soft-tissue reconstruction.[9,15-17,19-24] Once dehiscence occurs, the vital periosteum accelerates the re-epithelialisation and healing.[16] The muscle-sparing technique diminishes the donor-site dead space and subsequent haematoma, reduces the risk of the pedicle damage, promotes the skin-island pliability, and preserves the donor limb strength.[9] A precondition for the graft curvature, although time-consuming, is frequently coped with the gradual learning curve. In the disarticulated patients, condylar reconstruction using the distal end of the FFF is possible without damage to the vascular pedicle.[24]

Pogrel et al [25] reported the higher success rate of the FFF for mandibular defects more than 9 cm in length, compared with free bone grafts. Non-vascularised bone grafting is indicated only for small defects less than 5 cm in non-irradiated tissue and/or in medically unfit patients to tolerate microvascular head and neck reconstruction (MHNR) or when a defect includes bone only.[4,21]

The skin island of the FFF is usually sufficient for both skin and oral lining. However, in case of extensive soft-tissue loss, a double-free flap procedure [20] or a concomitant locoregional flap [23] may be considered. It is generally accepted that FFF and dental implant treatment are worthwhile procedures for oncologic patients.[4-6,15,19,20] However, only 2 patients in this series received this treatment due to a lack of the reimbursement of dental implant therapy in France.

2.2 Technical refinements

2.2.1 Perforators and skin paddle harvesting

Schusterman et al [18] demonstrated that 16 of 80 legs lacked septocutaneous branches. Nonetheless, all of our patients presented with significant-sized septal perforators. A muscular cuff of soleus and/or flexor hallucis longus (FHL) should be included in the flap when the septal branches are absent. Excessive soft-tissue incorporation causes flap bulk, and the FHL dissection is related to restriction in dorsiflexion and plantarflexion of the big toe.[9,26] Notably, musculocutaneous perforators are more abundant and proximal than the septal branches.[18] In this respect, a skin paddle of the septocutaneous FFF should be located in the middle and distal thirds of the leg, and may be divided based on the separate perforating vessels.[27] When the paddle size is excessive, it can be de-epithelialised with the preservation of the perforators to maintain the vasculature. Conversely, the skin flap can be abandoned in bone-only reconstruction.

2.2.2 Compromised vascularity and free flap failure

It remained unknown about the cause of the failed flap in our series because no sign of compromised vascularity was observed. Skeletonising the FFF using the muscle-preserving technique does not substantially affect the blood supply.[9] In our 2 patients with partial skin-island necrosis, the epidermis alone was denuded. The underlying tissues remained viable and the healing was uneventful.

The rate of free flap failure was approximately 1-15%, and was related to the patients' general health, age, previous history of surgery, cigarette smoking, nutritional status and long operative time.[19,22,28] The early recognition and timely management of flap complications is necessary because of a narrow window of opportunity to salvage potential flap failure.[14] A large series by Bui et al [14] revealed many factors involving venous thrombosis following MHNR, including the use of a vein graft, kinking or compressing of the veins with tight skin closure, neck motion, and end-to-end venous anastomoses. Arterial thrombosis was less common in that series. Without timely recognition, venous thrombosis would evolve into arterial thrombosis and subsequent no-reflow phenomenon. Thrombosis frequently occurs during the first 5 days following MHNR, necessitating close surveillance. Suh et al [28] found that the success of MHNR chiefly depended upon good pedicle orientation. To the best of our experiences, we recommend the reconstruction with a long pedicle containing the largest calibre vessels available (an external diameter exceeding 2 mm) without the use of a vein graft, and the end-to-side anastomoses of the veins.

2.2.3 Limited height of the neomandible

Height deficiencies of the FFF worsen vertical discrepancy between the graft segment and the dental occlusal plane. This also cause poor crown-root ratio of dental implants. Moreover, insufficient bone height in the symphyseal region precedes loss of chin projection and lip support.[15,20] The 'double barrel' technique [16,29] or alveolar distraction [30] can solve this problem. Otherwise, the vascularised iliac crest flap is an excellent option.[20]

In our department, we have now used the 'double barrel' technique to facilitate alveolar reconstruction.[29] The fibula can be harvested as long as possible with the protection of the distal tibiofibular joint stability by preserving over 6 cm of the distal fibula. Perpendicular osteotomies of the FFF and further folding must respect the fibular vasculature during the double-strut grafting. To avoid a cross-bite position of the graft, the upper segment should be placed lingually than the lower one. The intervening soft tissue between the 2 segments does not affect the graft stability and the fixture installation.[16,29] It is our experience that the ventral surface of the distal segment should be folded over the ventral surface of the medial one without subtle stretching or kinking the pedicle. Furthermore, compression from paramandibular tissue swelling on the pedicle is evitable if the pedicle is aligned lingually or inferiorly to the fibula.[29]

2.2.4 The use of miniplates

Many authors suggested the use of reconstruction plates to secure the free flaps.[4,6,16,19] In our patients, there was no complication from the use of miniplates. Furthermore, miniplates required only limited periosteal elevation in the FFF, allowing minimal vascular damage.[29] The use of miniplates seems durable and trouble-free in this study.

2.3 Disadvantages

There are many limitations in our treatment strategy. First, patient's general health and lower leg conditions (such as a 'two vessel' leg, obvious arteriosclerotic changes, pre-existing gait disturbance, significant previous leg trauma) limit the candidates for this intervention.[15,17,29] The SM-IFFOFR is also technically sensitive, requiring proper training and elaborate equipments. Second, skin grafting is obligatory in case of a large skin island (> 4 cm in width) or noticeable tension on donor wound closure. Tight closure of a wide donor-site wound may cause the compartment syndrome.[9,26] Third, there is hair in the flap, yet it usually disappears over time. None of our patients expressed displeasure. Forth, the flap is usually bulky and lacks of a vestibular sulcus, and subsequently impairs speech, deglutition and dental rehabilitation.[6] In this manner, some patients need surgical reshaping. Fifth, as mentioned above, its limited height may dictate the use of the 'double barrel' technique [16,29] or alveolar distraction.[30] Finally, donor-site morbidities which include pain, muscle weakness, knee and ankle instability and foot numbness are possible, but rare.[4,5,16,19,20,29]

3. Study limitations

We are aware of the retrospective design, the small size of the series, and a relatively short duration of follow-up. However, GMA is rare in France. Many of our patients were immigrants from countries with inadequate access to health care. Moreover, we assume that the SM-IFFOFR should increase the cure rate. In our department, the method reported herein has been the treatment of choice for extensive tumours over a decade. As a result, a randomised controlled trial seems infeasible. It should also be emphasised that with the gradual learning curve, careful flap selection and continuing the use of some, but familiar, flaps leads to reliable outcomes with few complications.[15]

An obvious shortcoming of this series is that one of 2 assessors was the main operator. Thus, our report may be at risk of bias. Nonetheless, the second evaluator and the third party counterbalanced this possible drawback. Since detailed information on aesthetic and functional outcomes was not consistently available in the patient charts, a prospective outcome research on this matter is under way in our institution.

Notably, this study does not represent a population-based registry in France because there is a relatively low incidence of GMA in Whites, and our hospital is for adults only.

Conclusion

Our experiences based on a single team's experience in a teaching hospital indicated that the SM-IFFOFR was a plausible way for managing GMA. This method permitted optimal results with relatively rare complications. Nonetheless, our report seems not to be a conclusive assessment. A larger number of cases and longer follow-op periods remain necessary.

Acknowledgement

This article was completed in partial fulfilment of the requirements for the ‘Doctorat de sciences’ (PhD) degree at the University Paris 5 (René Descartes) and the ‘Doktor der Zahnheilkunde’ (Dr.med.dent.) degree at the University of Leipzig by the second author.

Conflict of interest

The authors state that they have no conflict of interest.

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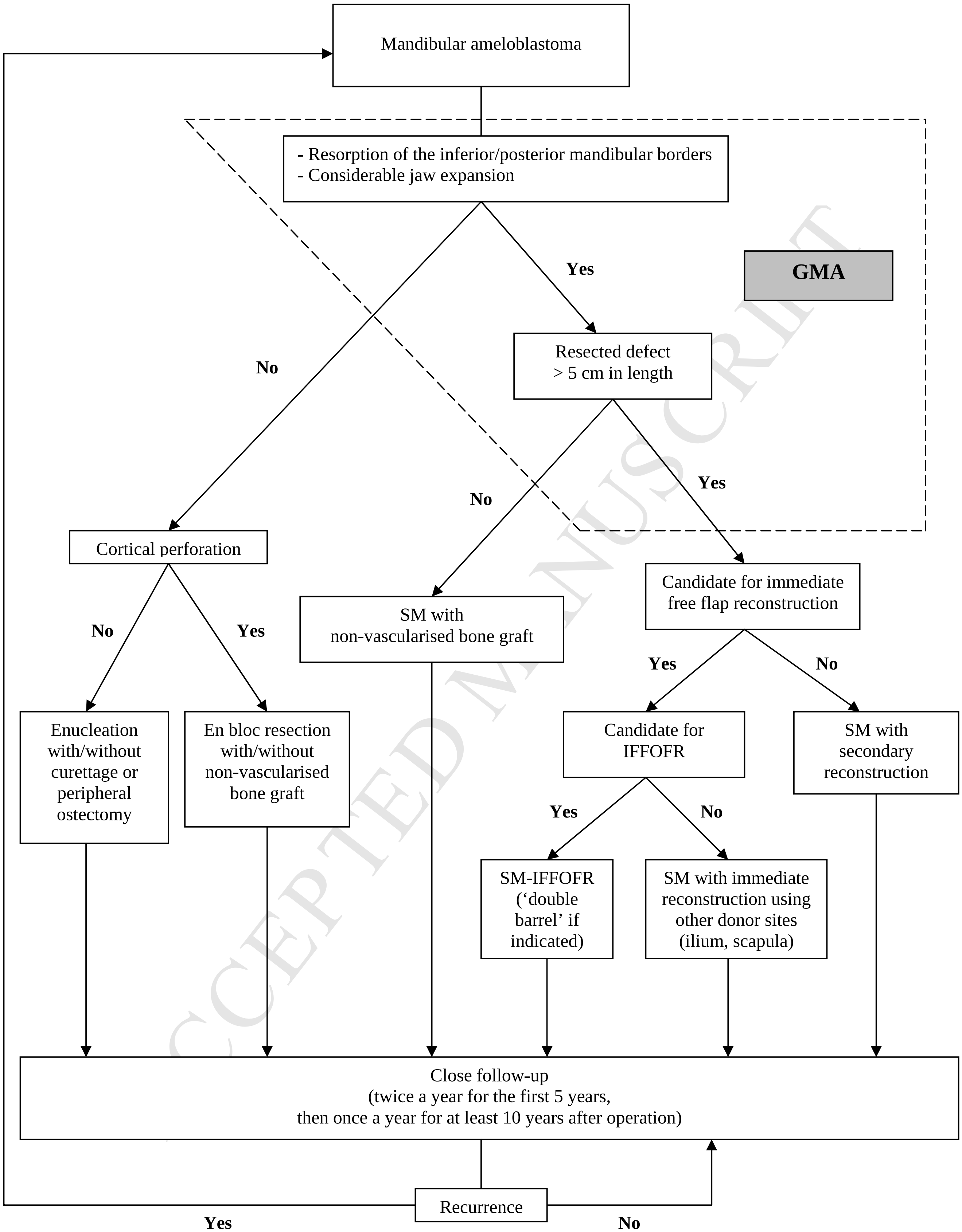
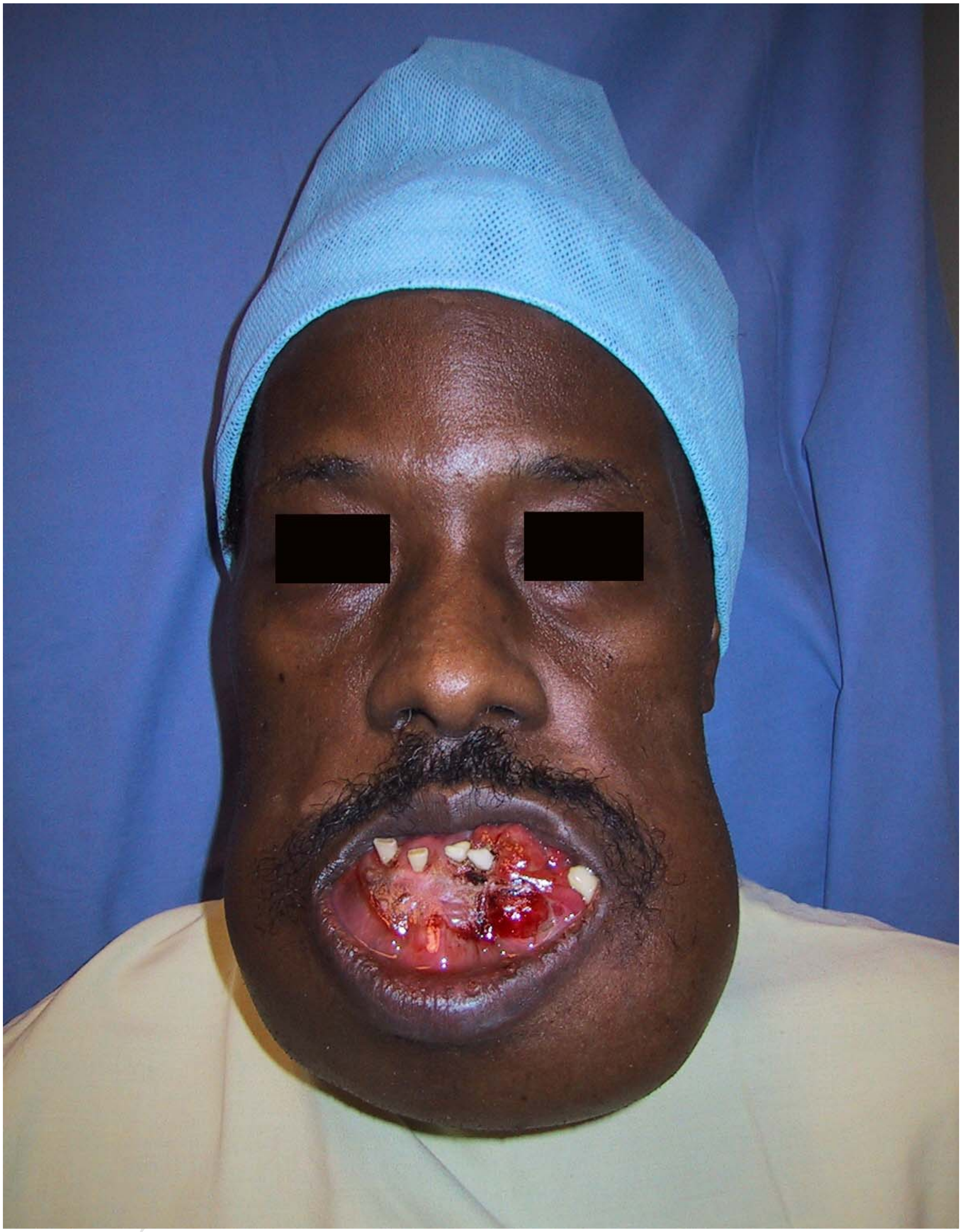
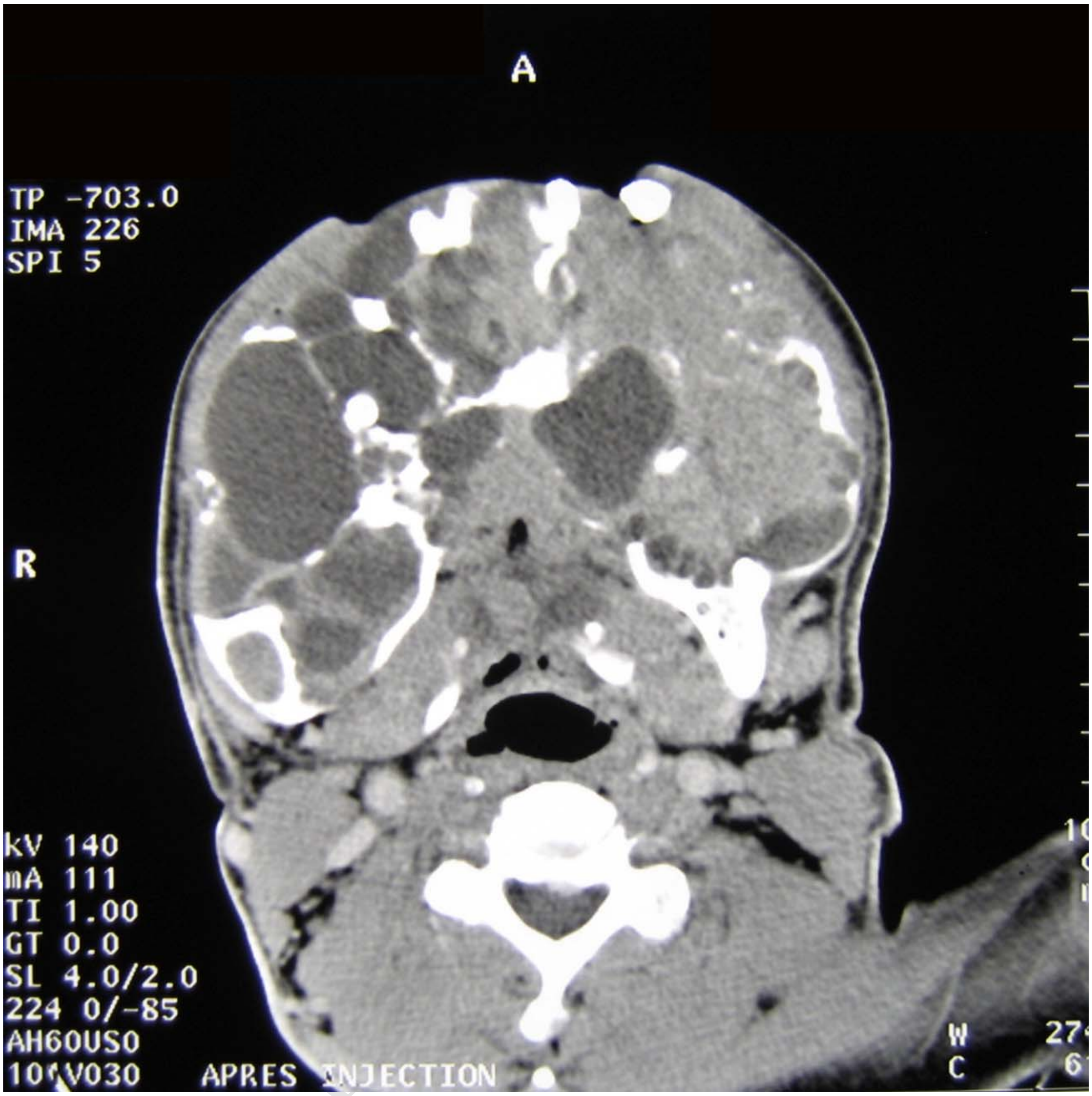


Fig. 1 Algorithm for managing mandibular ameloblastoma

Fig. 2 A 44-year-old man presented with GMA (LCL defect). A: Preoperative frontal view, B: Preoperative CT (axial cut), C: Preoperative CT (3-dimensional), D: Resection specimen. E: Postoperative panoramic radiograph at 4 years (Note: one ‘sleepy’ dental implant has been left *in situ*, although it is not used as support for the denture).

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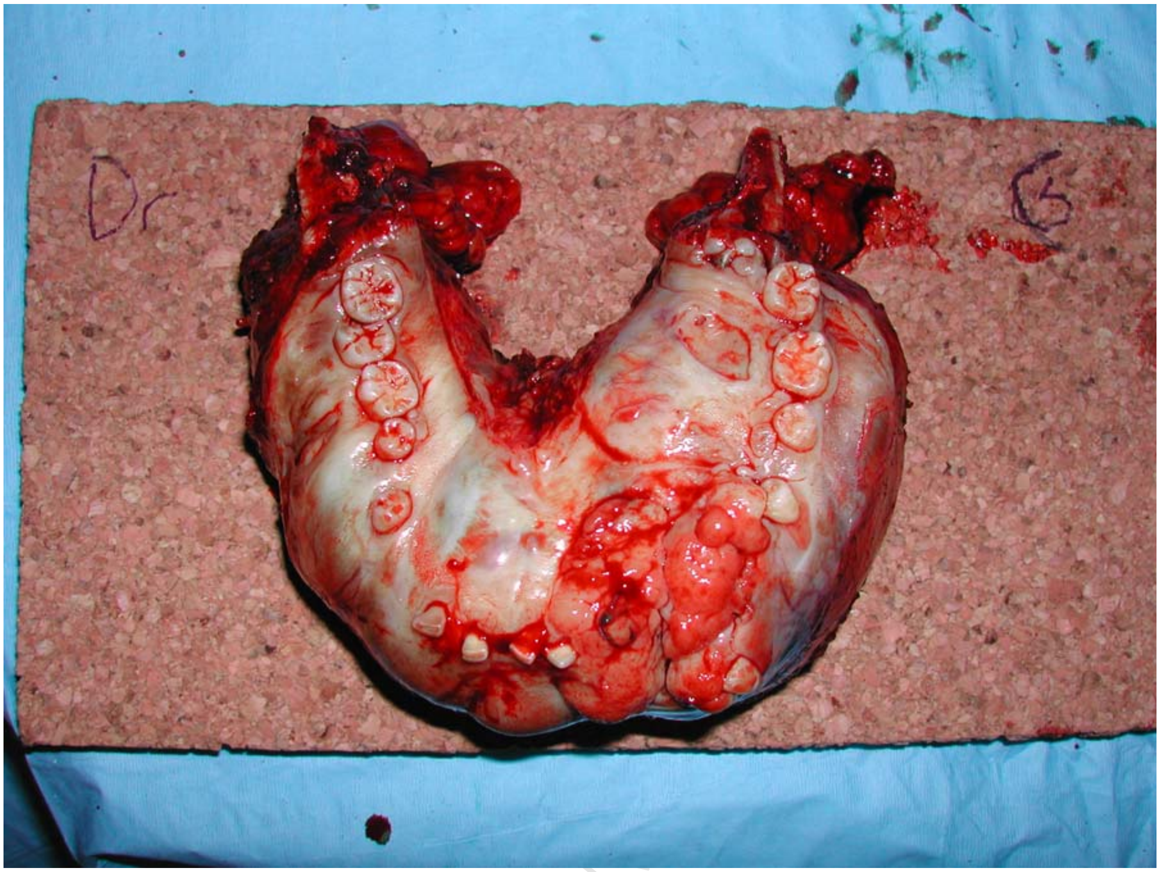
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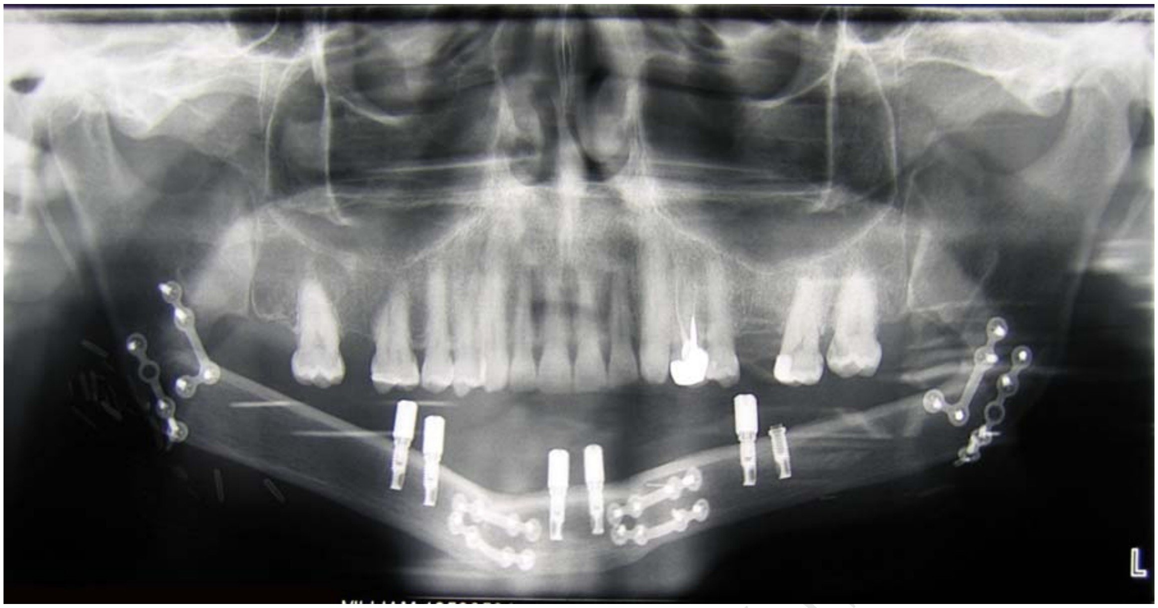
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